AROME wind at sub-kilometer resolutions

Imanol Guerrero Peralta

Project 5 : Development and evaluation of models of numerical weather prediction of high resolution

Francisco Javier Calvo Sánchez

Area of Modelization

Development and applications department

AEMET

Outline

- Brief description of the Harmonie model
- Physiographic dataset
- Design of the experiments
- Show results
- Verification: Model vs. Observation
- Conclusion and further work

Brief description of the Harmonie model

- The Harmonie model is a non-hydrostatic spectral limited area model. Developed by Meteo-France and ALADIN in collaboration with ECMWF and HIRLAM.
- HARMONIE is built upon the ALADIN-NH dynamic core, which is a bi-Fourier spectral (assuming an extension zone biperiodization of fields). The NH dynamical core is based on Bubnová et al (1995). It uses a two-time level semi-implicit semi-Lagrangian discretization of the fully elastic equations with a hybrid coordinate in the vertical
- Several parameterizations configurations are possible: **AROME** physics below 2.5 km, ALARO physics for “grey scales” (2-9 km) and ALADIN, HIRLAM or ECMWF physics for resolution above 10 km
- The AROME physics is identical to the corresponding schemes Meso-NH model. Microphysics (ICE3),turbulence TKE, dry and moist convection in the BL EDKF or EDMF, for the surface processes SURFEX is used, the ECMWF radiation schemes are used.
- The HARMONIE data assimilation uses a 3D-Var scheme which is derived from the ALADIN/IFS models.

Physiographic dataset

- Orography : GTOPO30 (DEM), with a horizontal grid spacing of 30 arc seconds (~ 1km)
- Soil texture: FAO, 10km
- Land use: ECOCLIMAP, 1km
  - depending on soil
    - Percentage of sand and clay
    - Soil depth
  - depending on vegetation
    - Fraction of vegetation (veg), Leaf area index (LAI), Minimal stomatal resistance, Roughness length (zo)
  - depending on soil and vegetation
    - Albedo, Emissivity

Design of the experiments

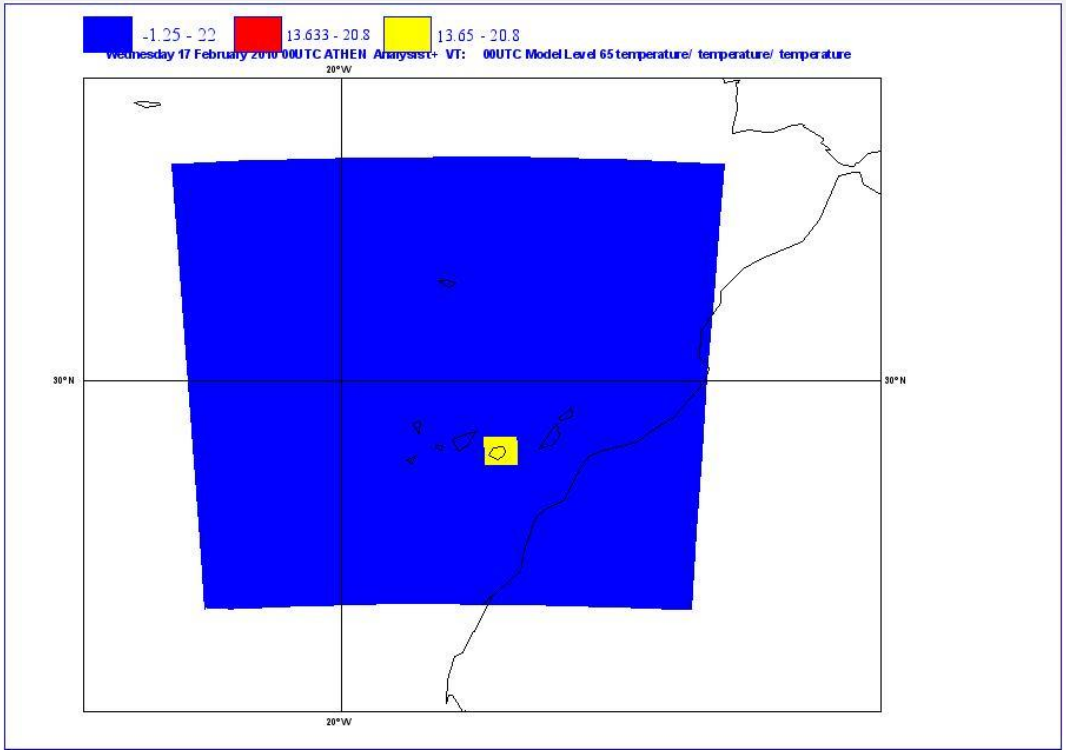
- Study area: Gran Canarias (Complex terrain)

(latitude ~28º, longitude ~ -15º)

- Date: 2010/02/17
- Physics vs. non physics

experiments

- Orographic file:
  - GTOPO30 ~ 1km
  - MDT200 ~ 200m
- Projection: Lambert
- Vertical levels: 65



Design of the experiments

Cycle:36h1
Version:04

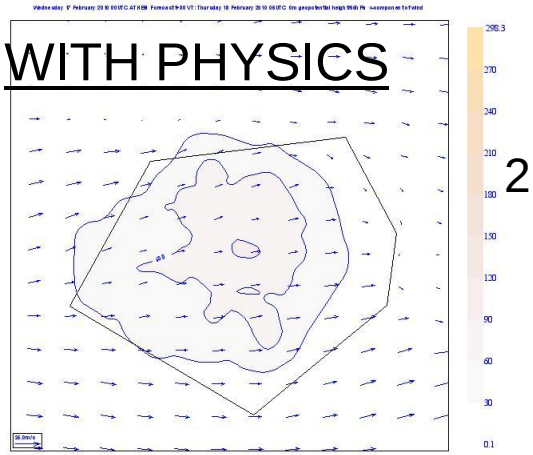
Main fractures of setting model

	Name EXP.	Horizontal Resolution(m)	Host model (boundary interval)	Numerical time step (s)	NLON/NLAT
Physic GTOPO30	aic_25_36h14	2500	Ifs (3h)	60	576/576
	aic_10_36h14	1000	Arome (1h)(2)	30	100/100
	aic_05_36h14	500	Arome (1h)(2)	10(3)	200/200
No-physic(1) GTOPO30	aic_25_36h14nphy	2500	Ifs (3h)	60	576/576
	aic_10_36h14nphy	1000	Arome (1h)(2)	30	100/100
	aic_05_36h14nphy	500	Arome (1h)(2)	10(3)	200/200
Physic MDT200	aic_10_36h14_200	1000	Arome (1h)(2)	30	100/100
	aic_05_36h14_200	500	Arome (1h)(2)	10(3)	200/200
	aic_025_36h14_200	250	Arome (1h)(2)	3(3)	400/400

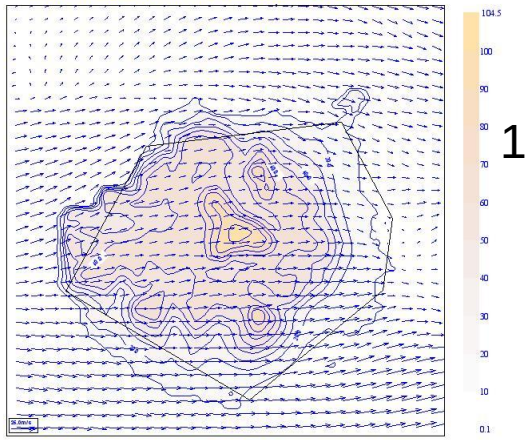
(1) Override the physics and diagnostics (flow and accumulation)
(2) Nesting used: experiment aic_25_36h14 and in the case no-physic experiment aic_25_36h14nphy
(3) Stability problems; Semi-lagrange trajectory out of the atmosphere and wind velocity is too strong.

Results physics and non physics

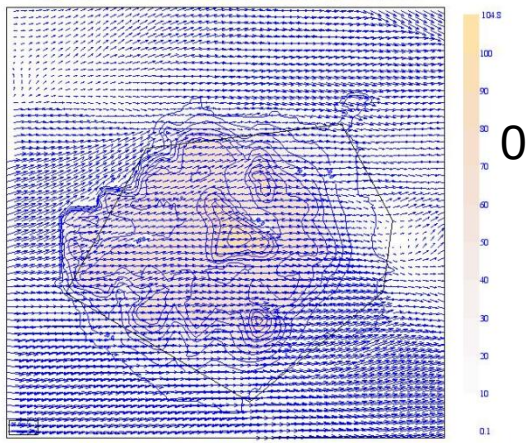
WITH PHYSICS



2.5 km



1 km



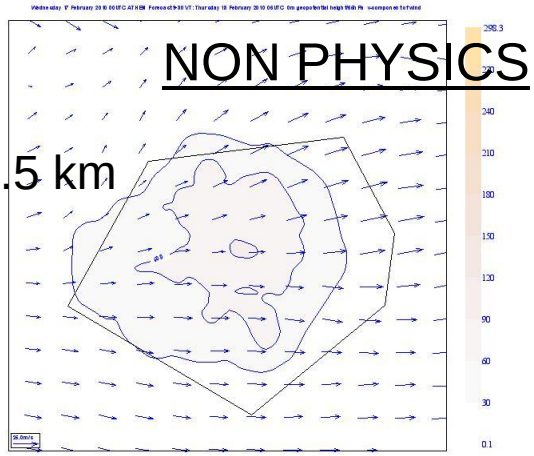
0.5 km

Model level = 65

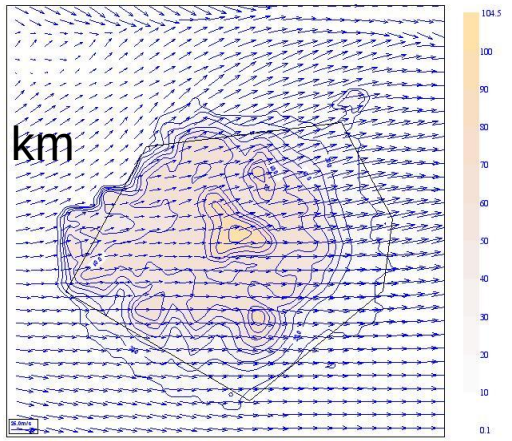
Param = wind

Forecast = t+30h

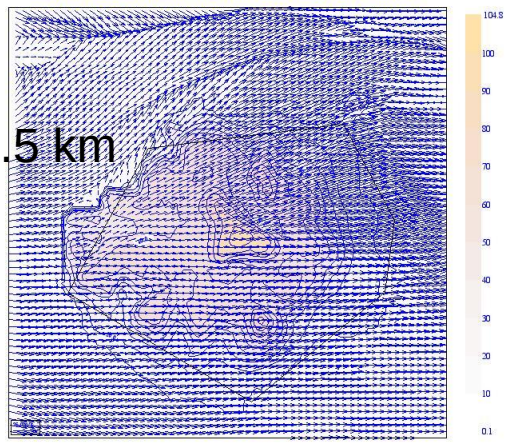
NON PHYSICS



2.5 km

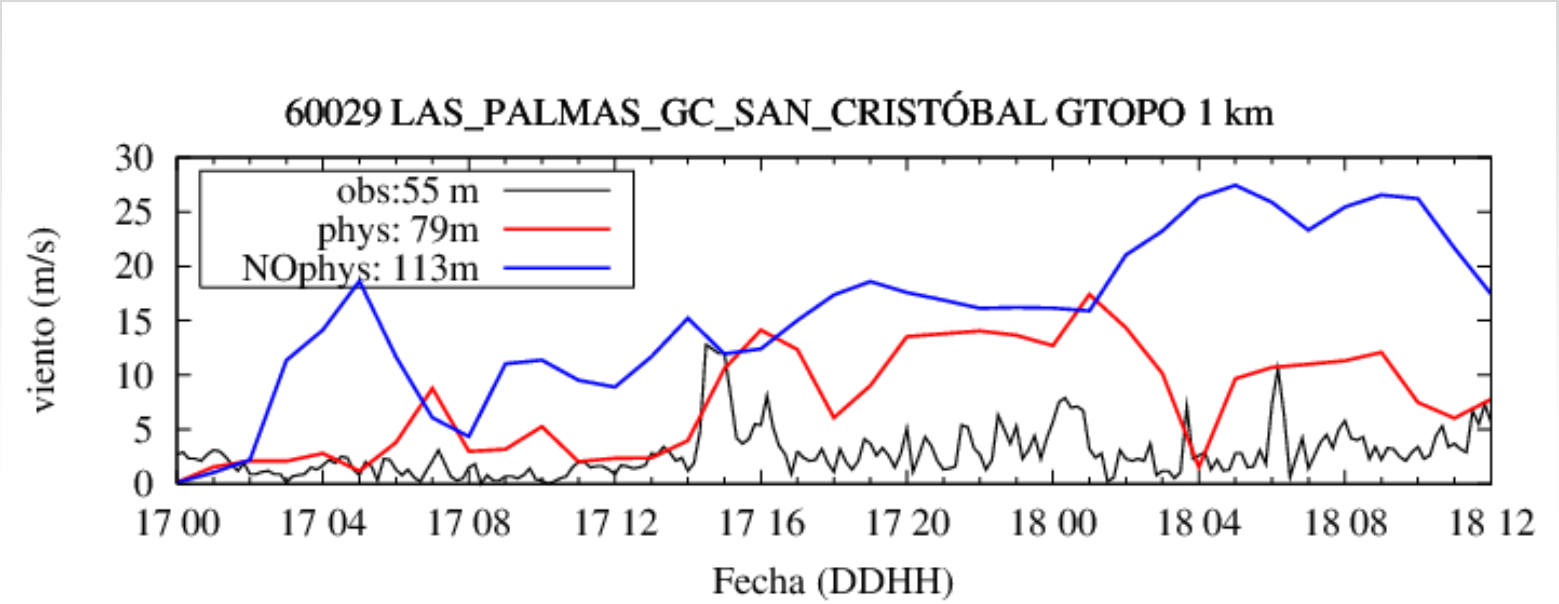


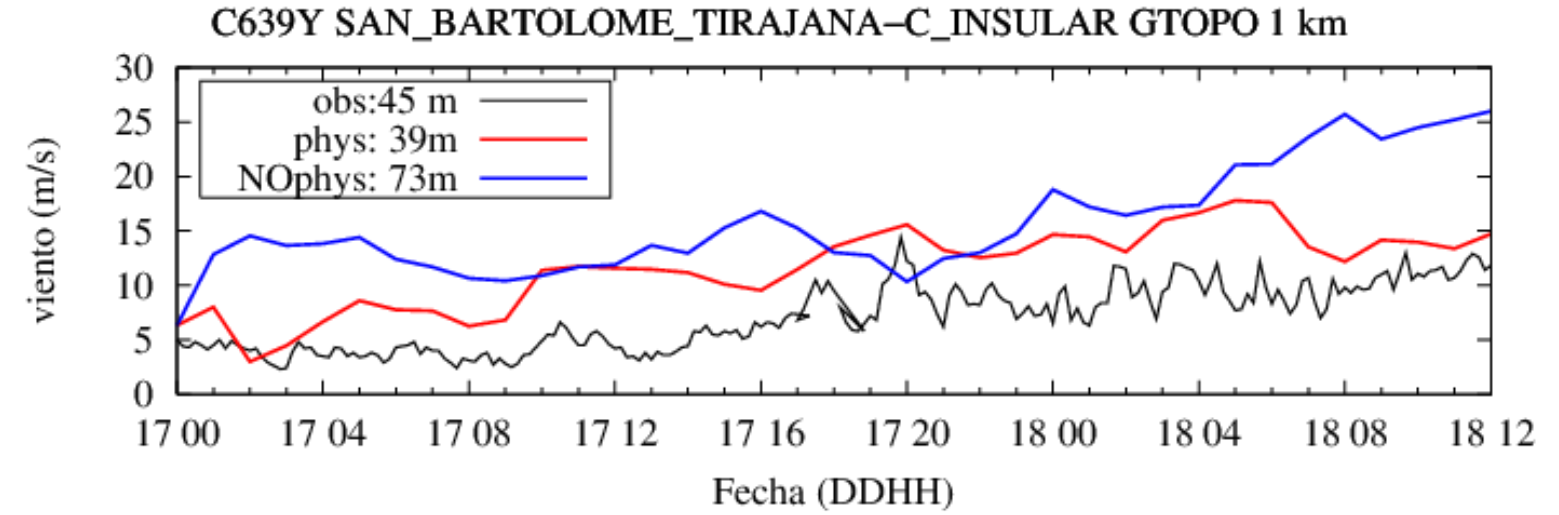
1 km



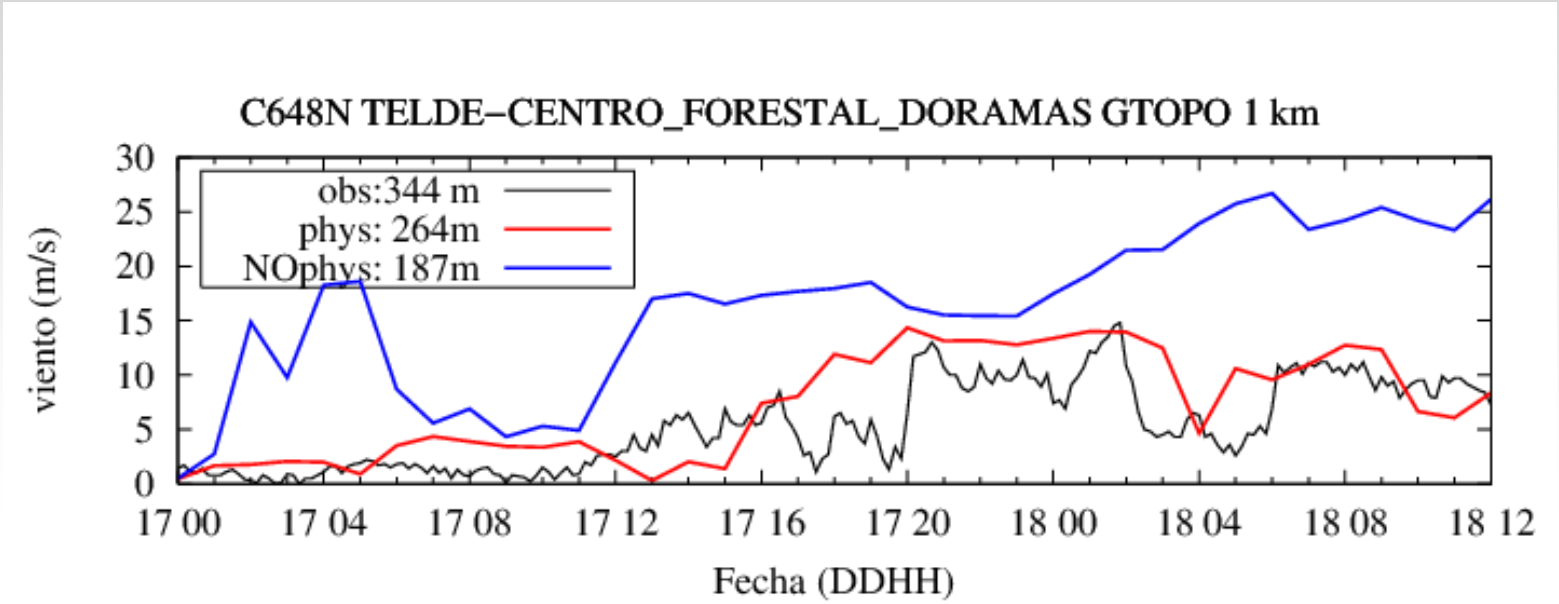
0.5 km

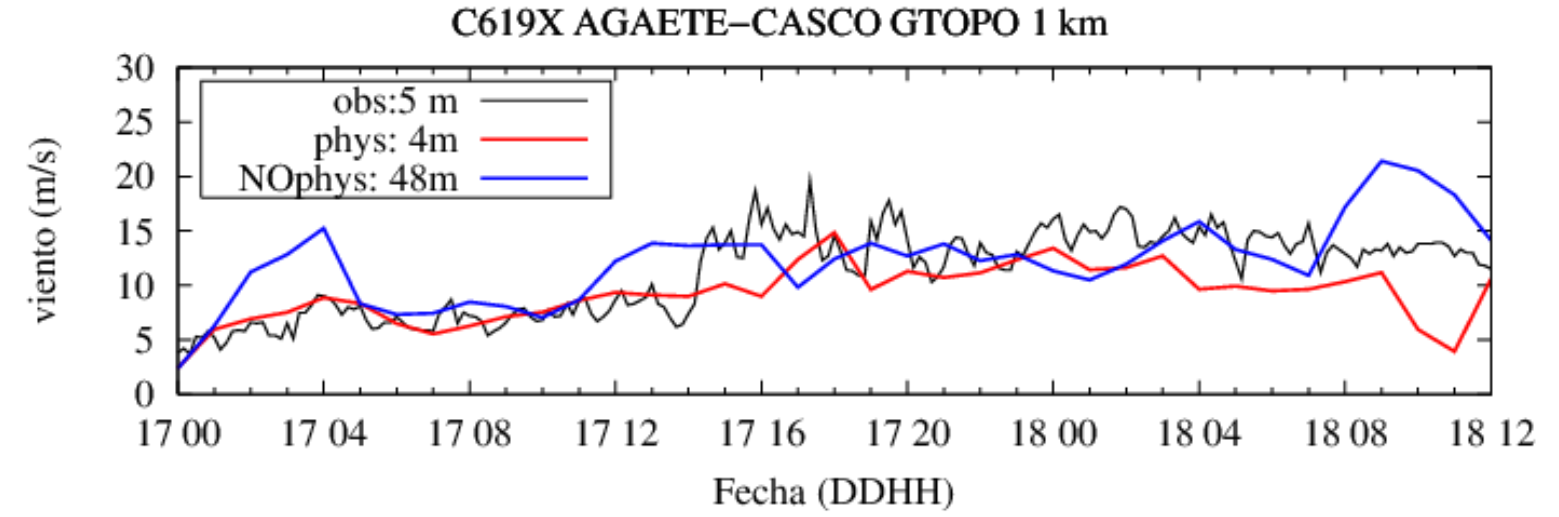
Verification: Model vs. Observation physics and non physics





Verification: Model vs. Observation physics and non physics





Results GTOPO30

Level type = sfc

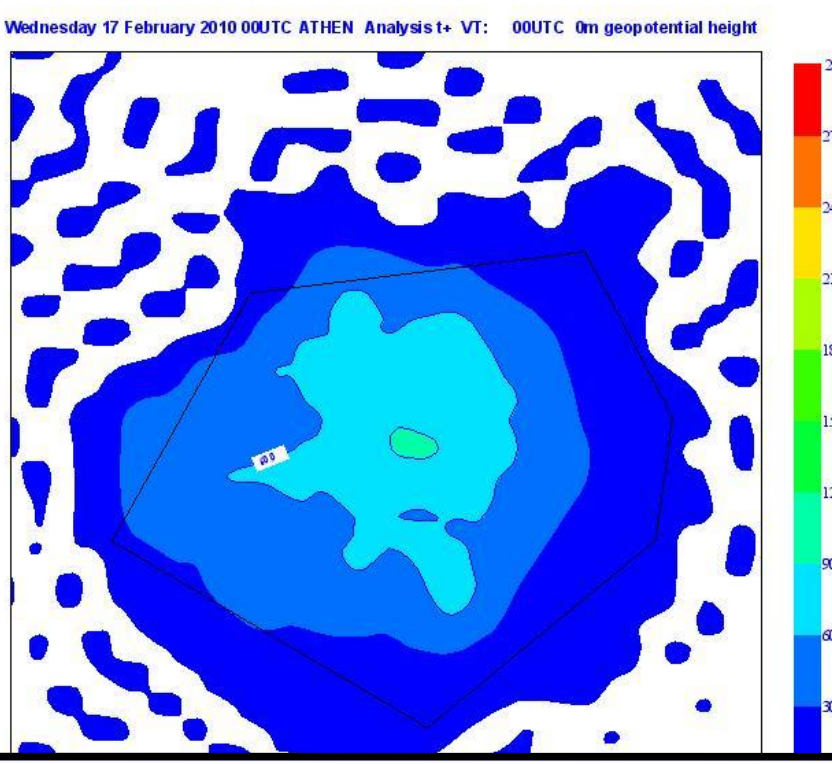
Param = z

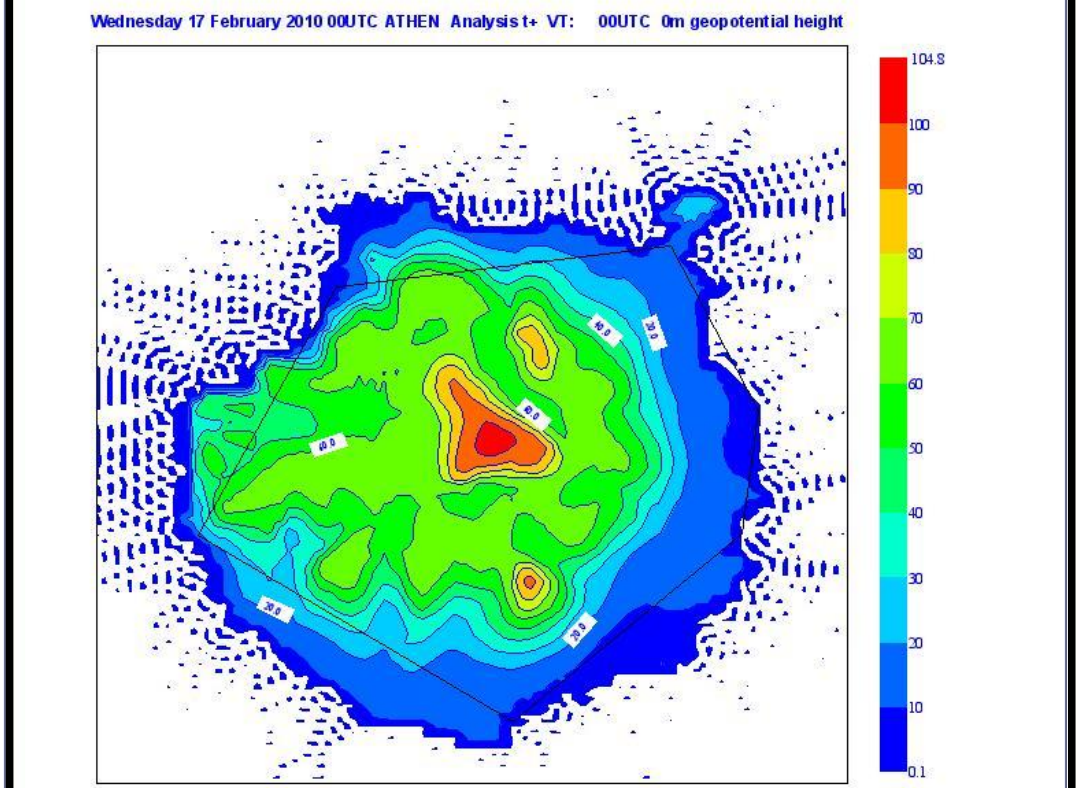
Forecast = +36h

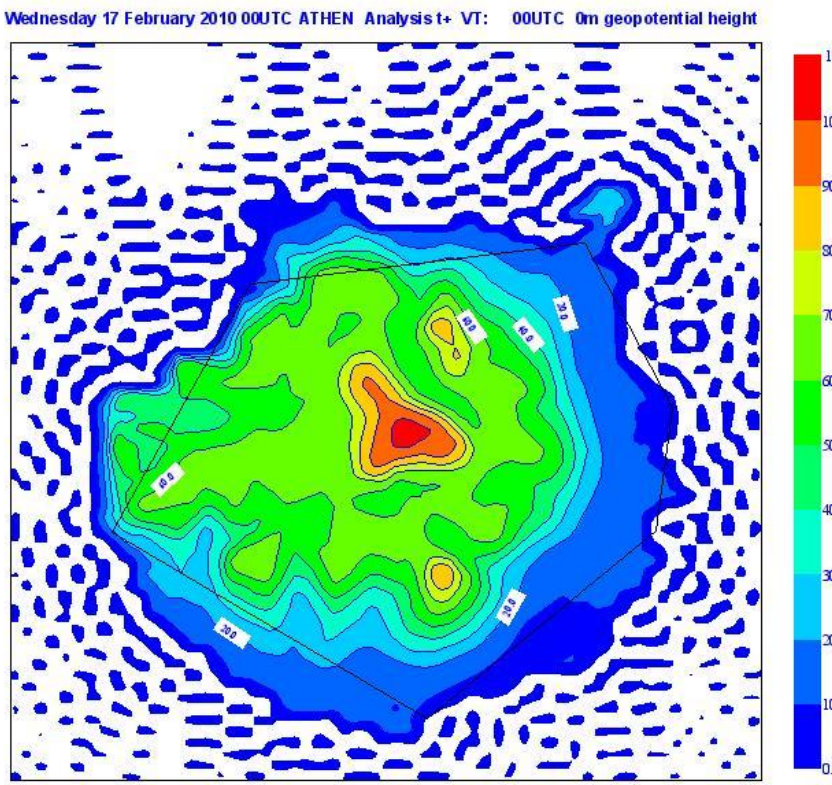
2500 m

1000 m

500 m







Results GTOPO30

Level type = sfc

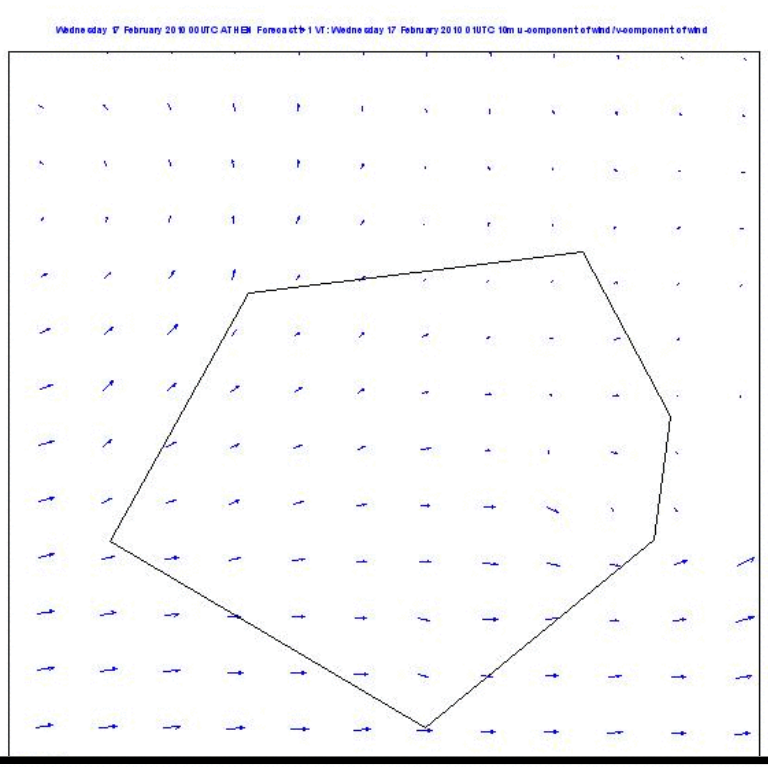
Param = 10m wind

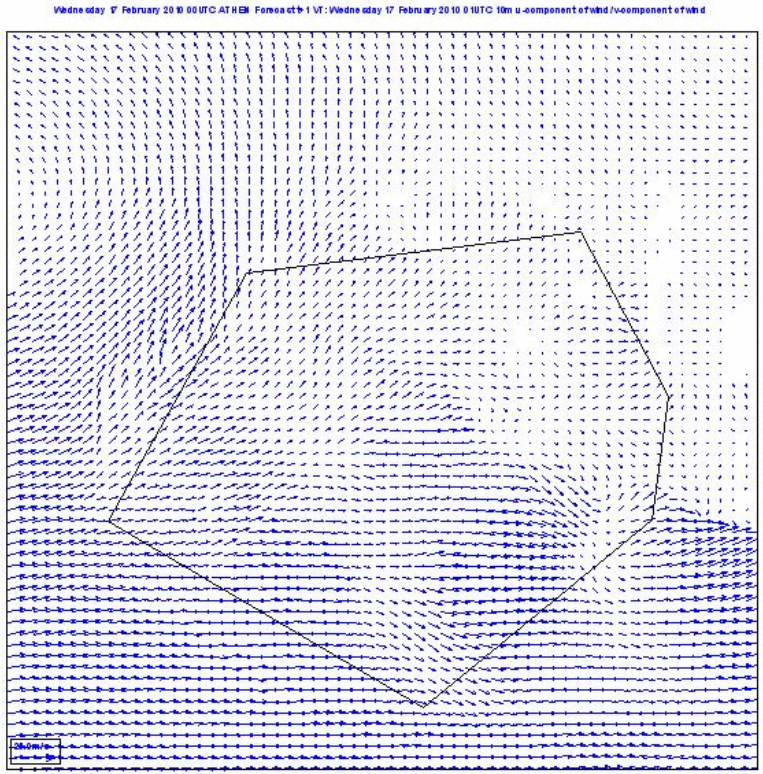
Range = +36h

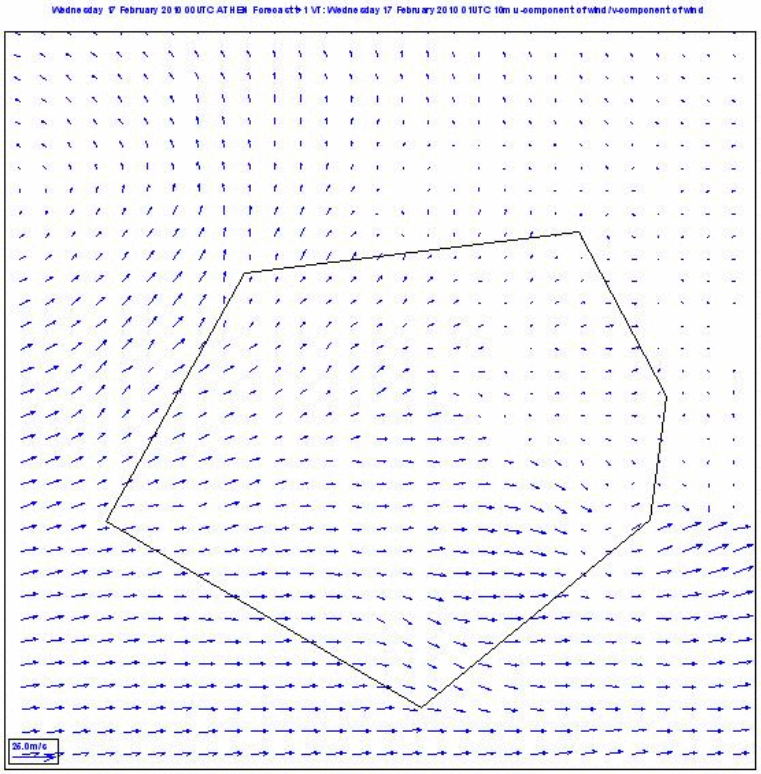
2500 m

1000 m

500 m







Results MDT200

Level type = sfc

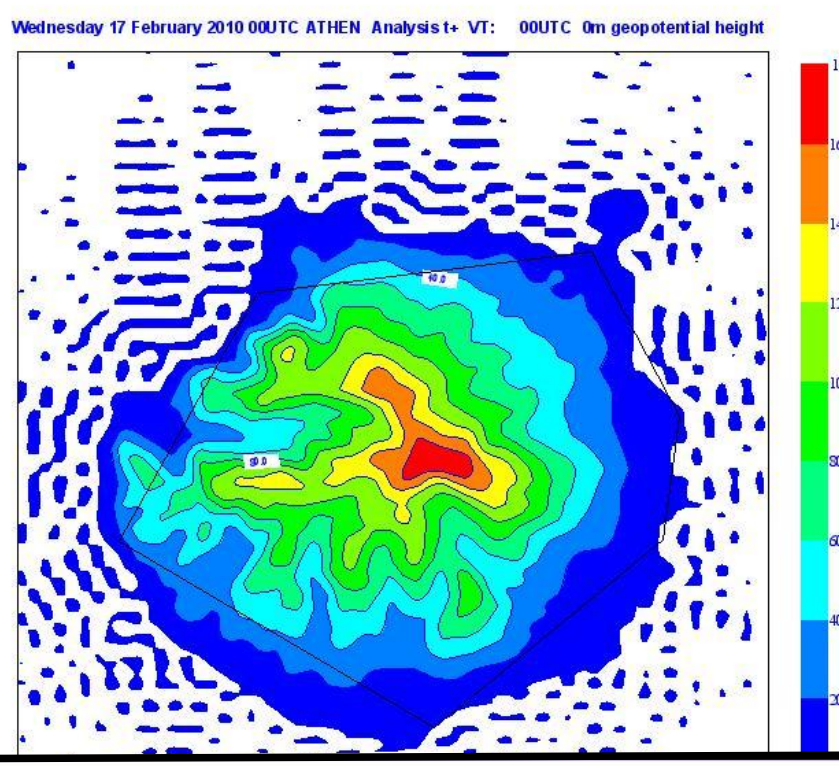
Param = z

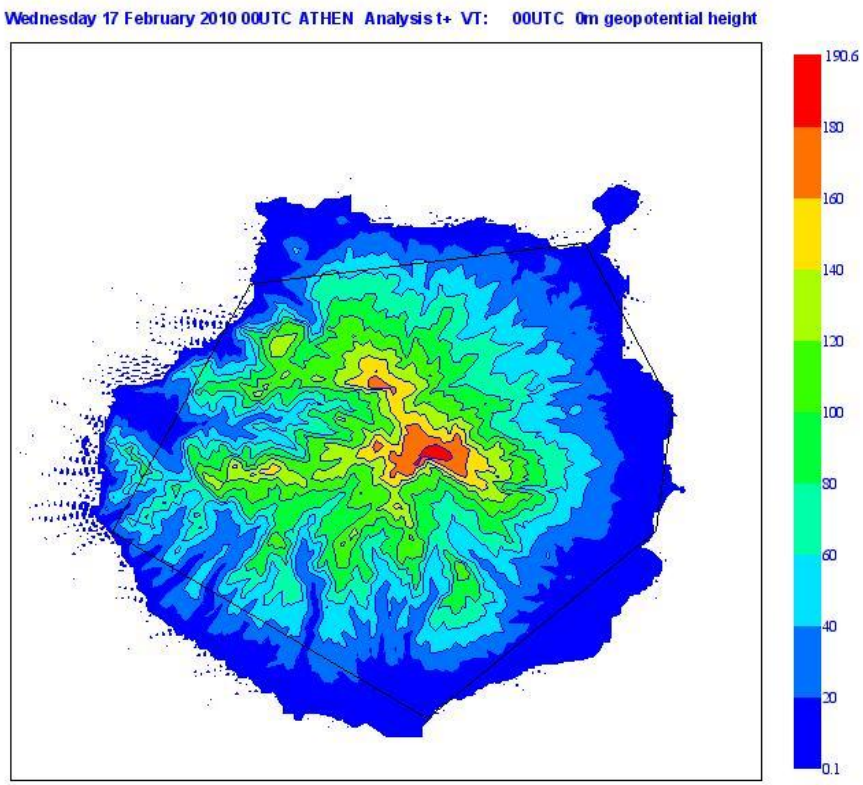
Forecast = +36h

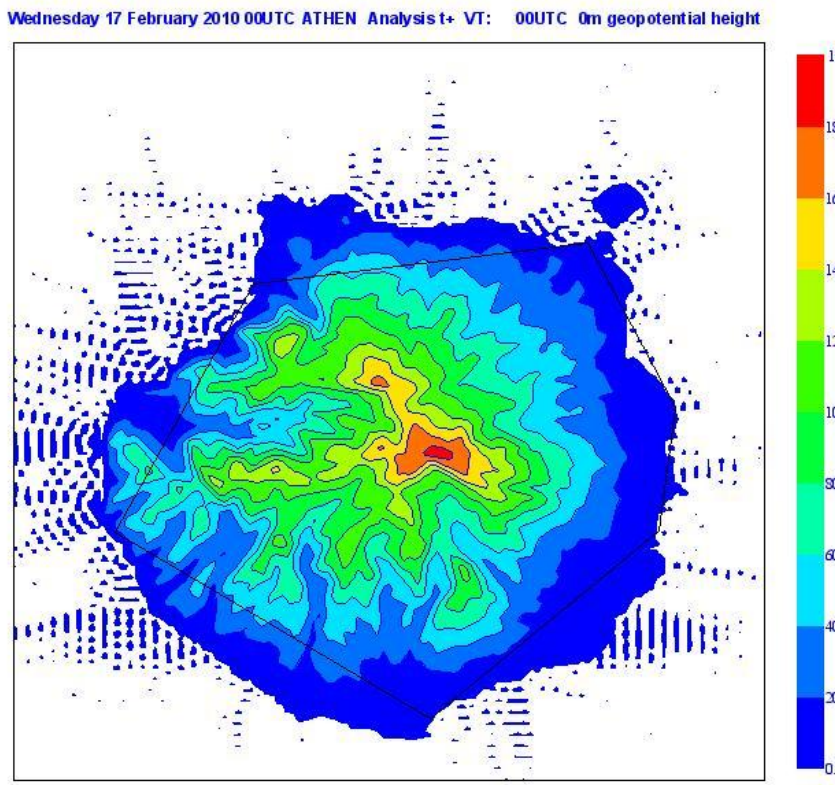
1000 m

500 m

250 m







Results MDT200

Level type = sfc

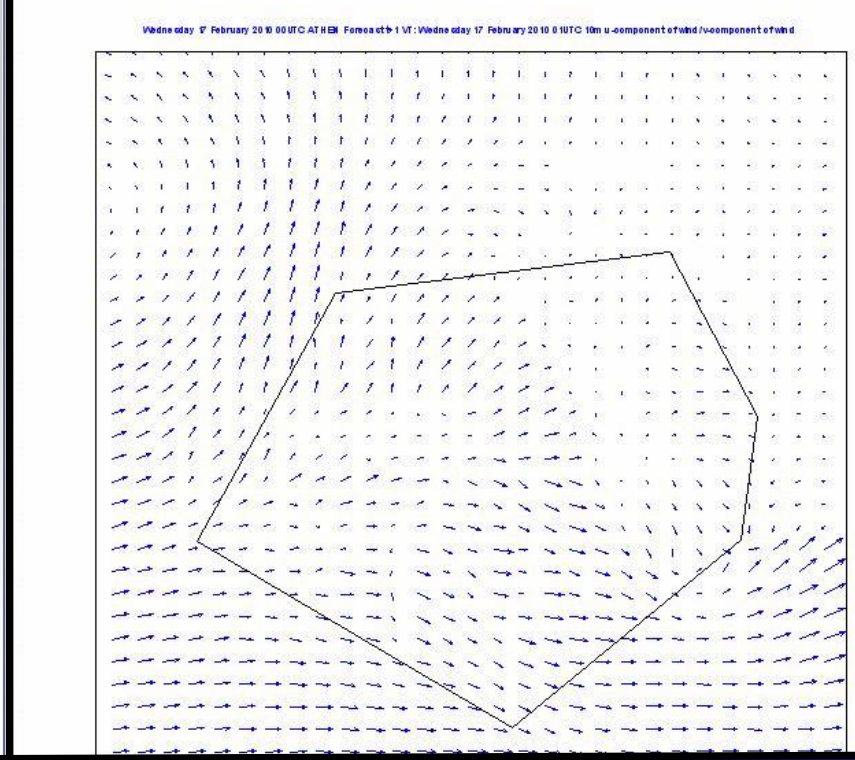
Param = 10m wind

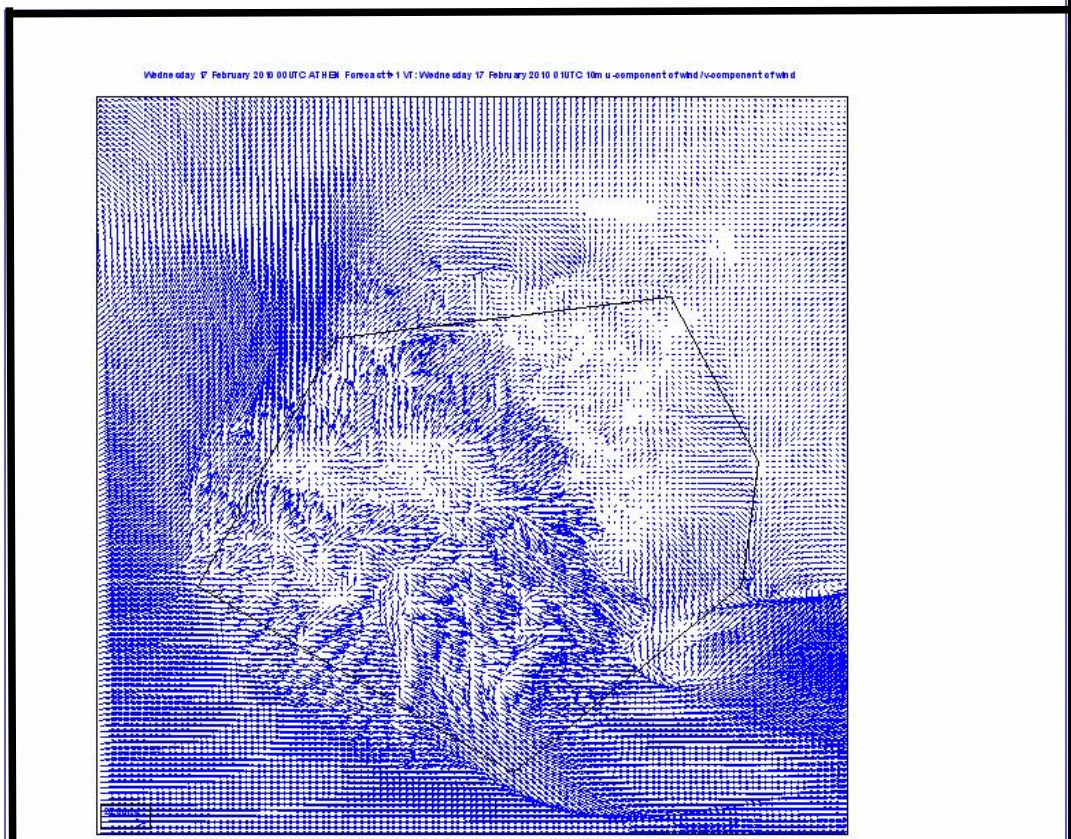
Range = +36h

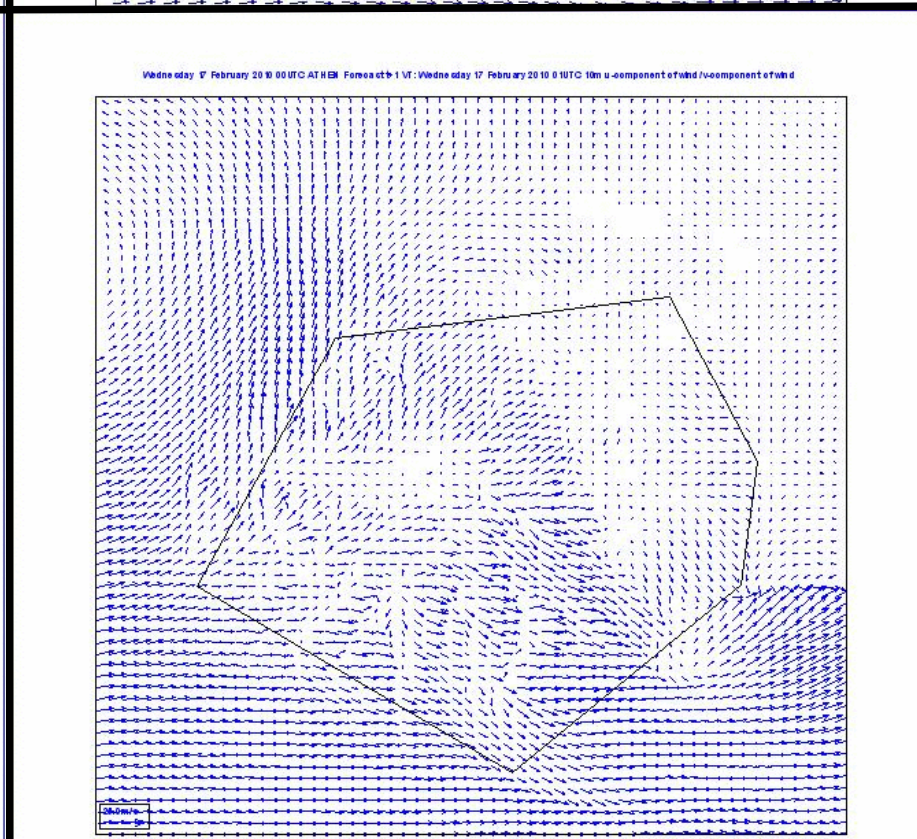
1000 m

500 m

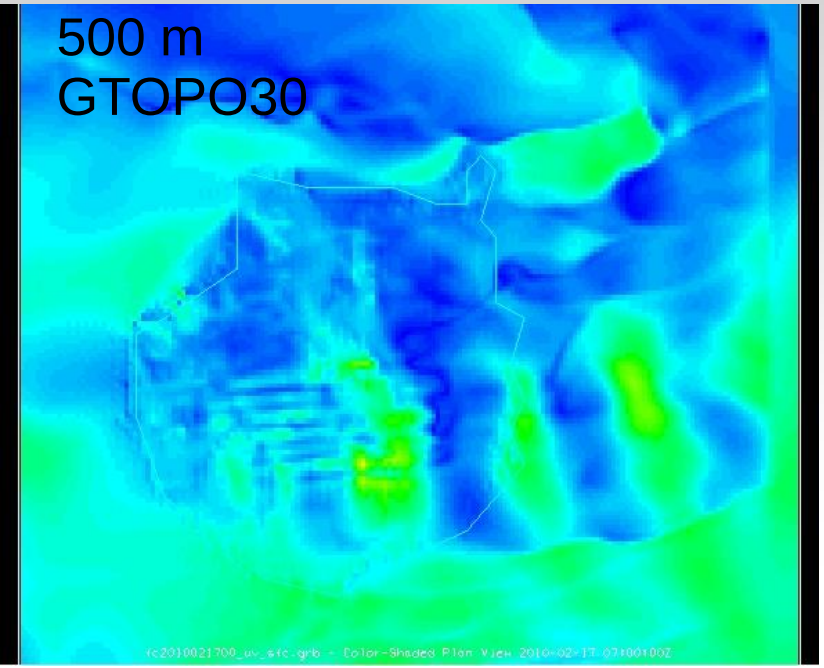
250 m

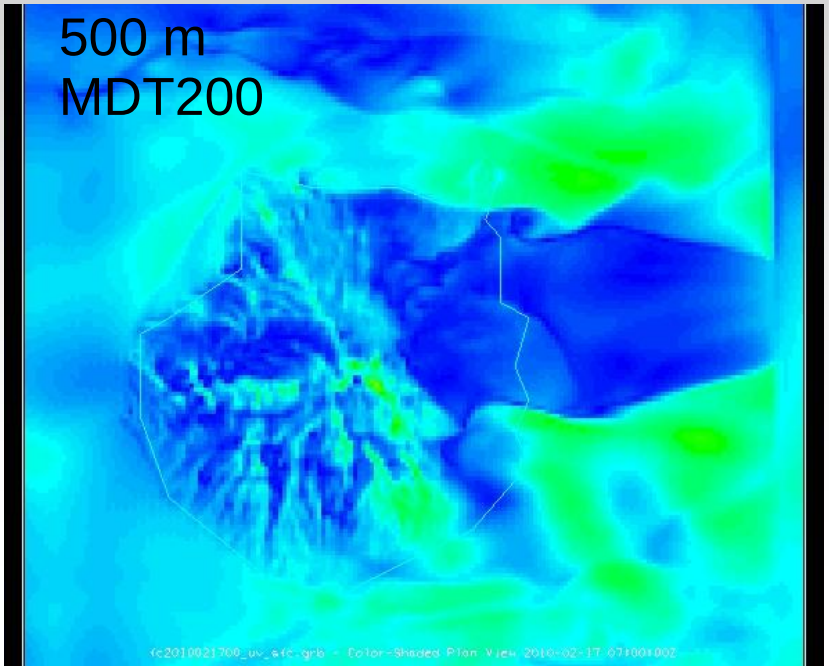


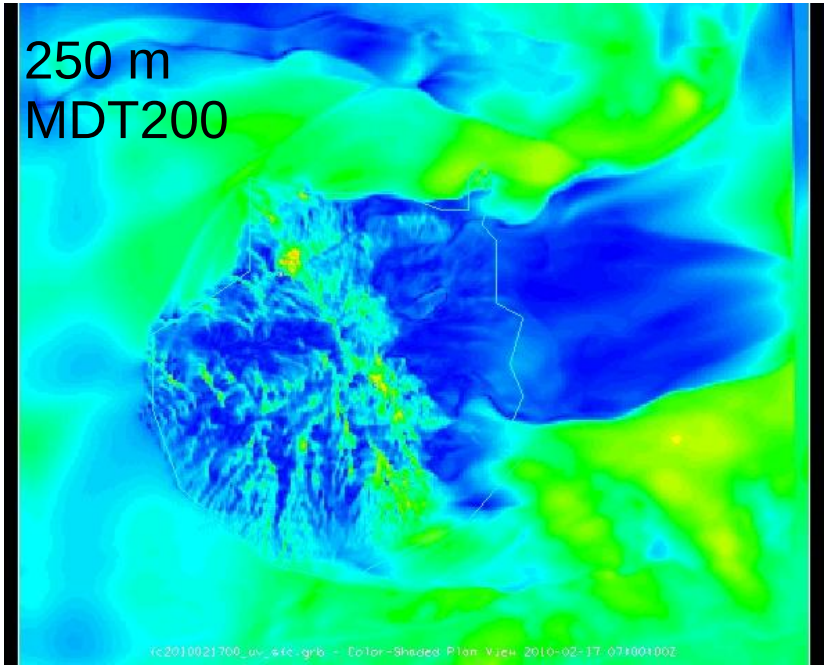




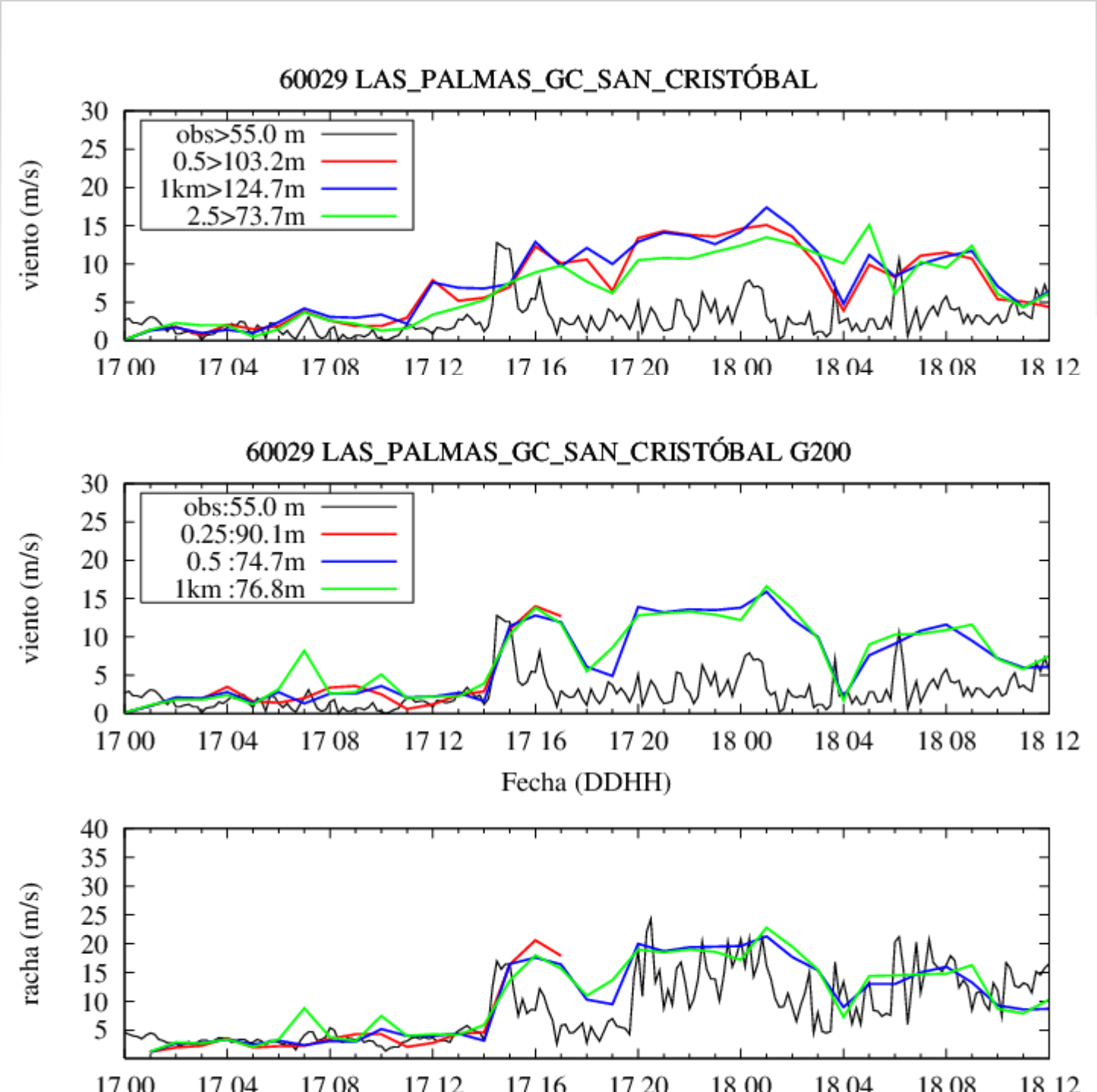
Results

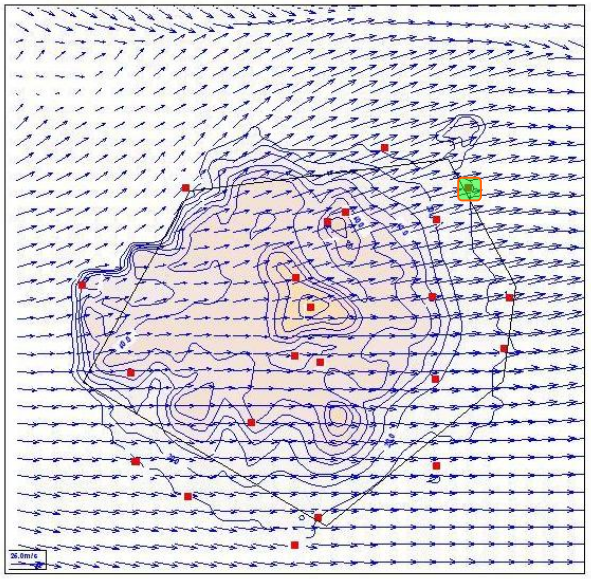




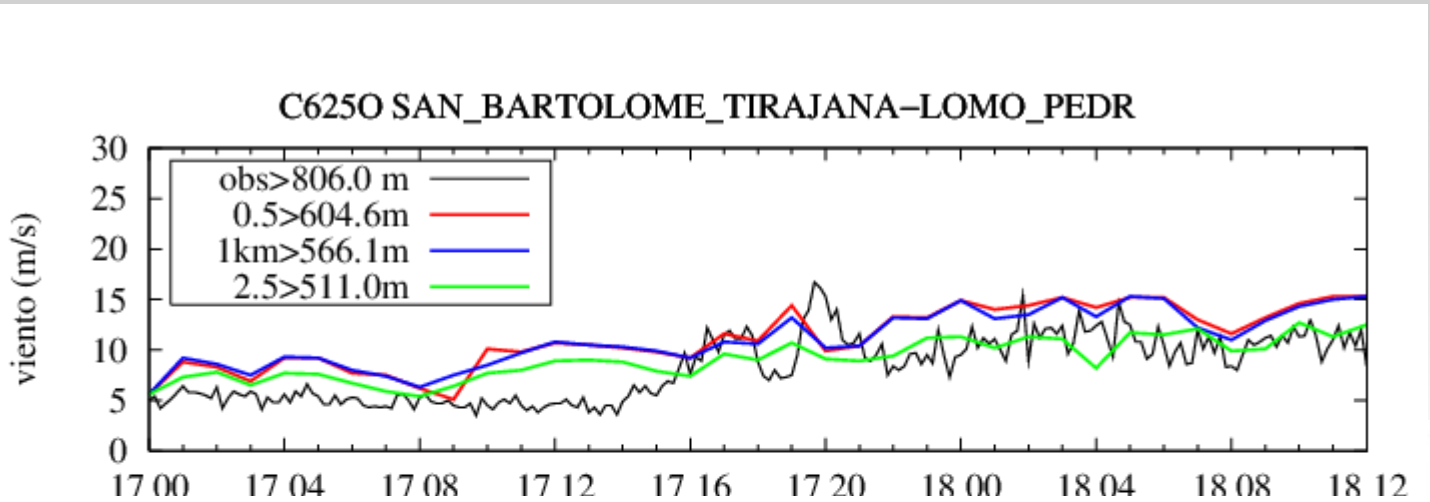


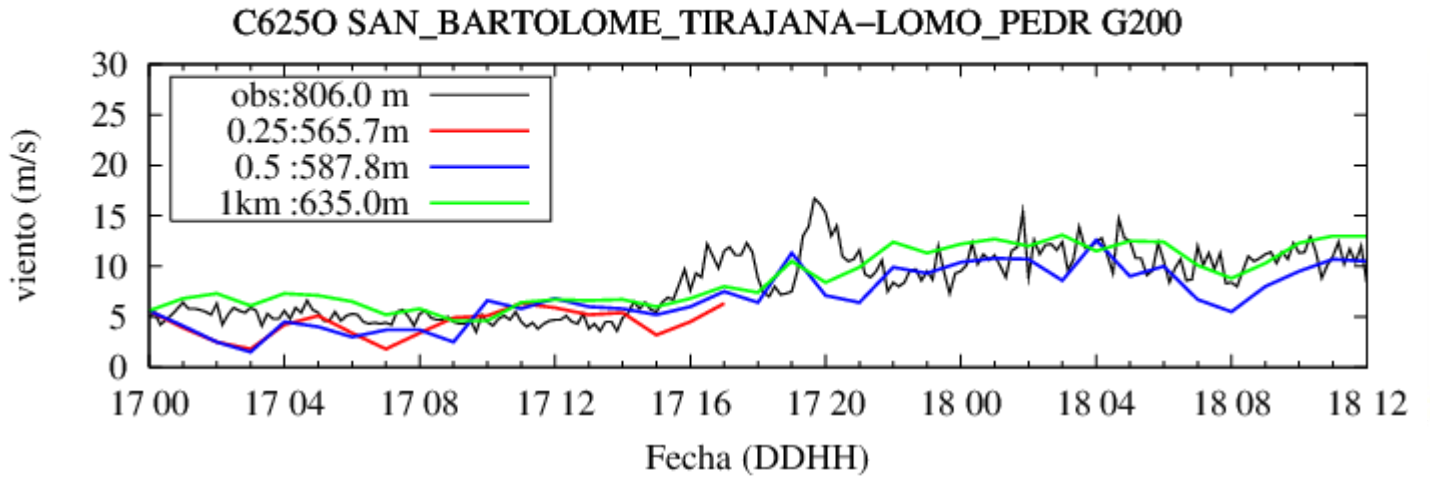
Verification: Model vs. Observation

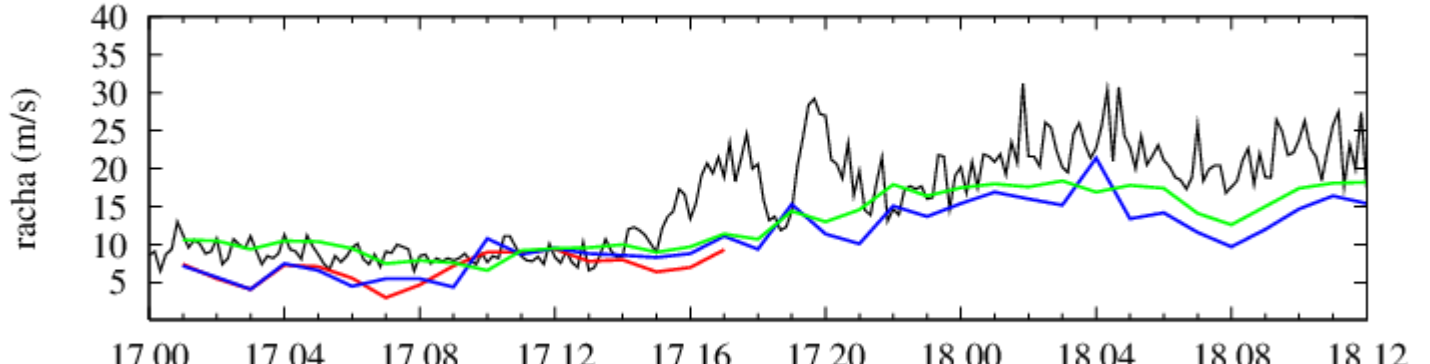


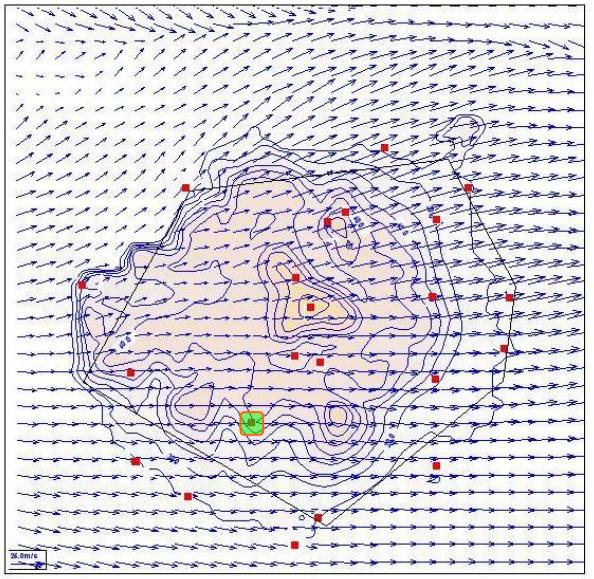


Verification: Model vs. Observation









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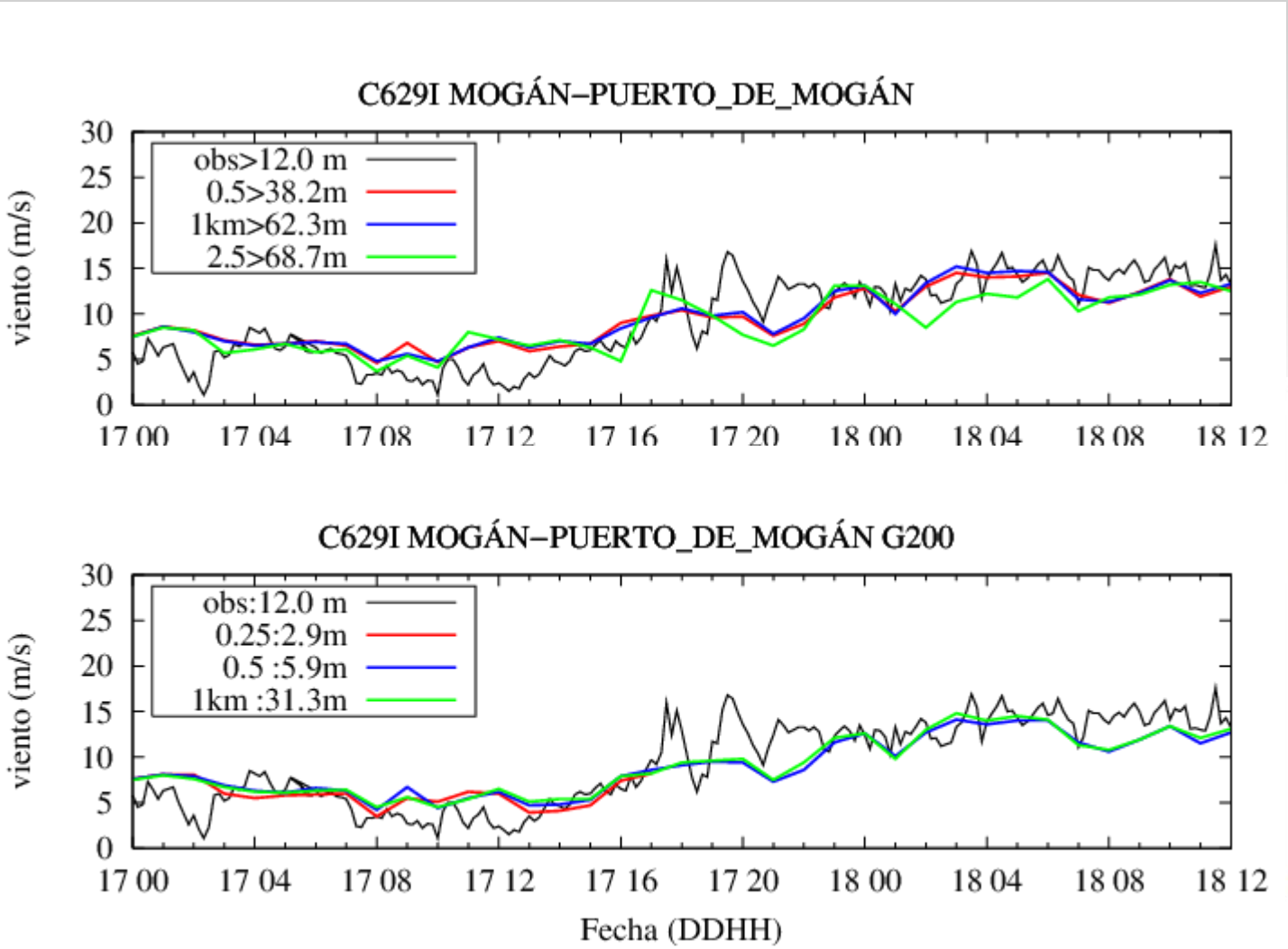
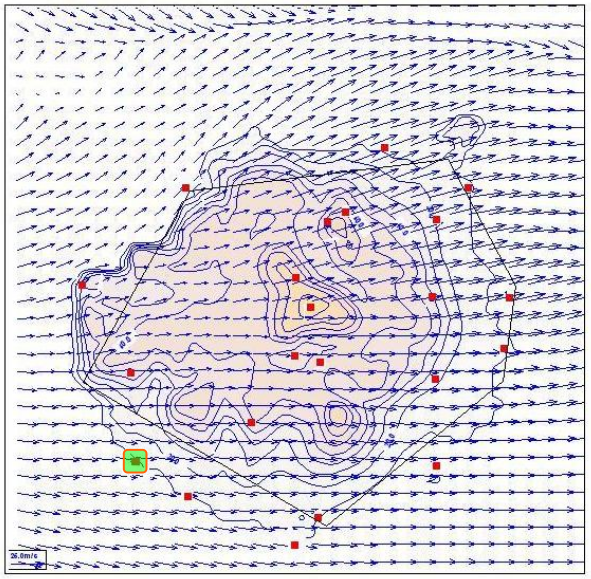
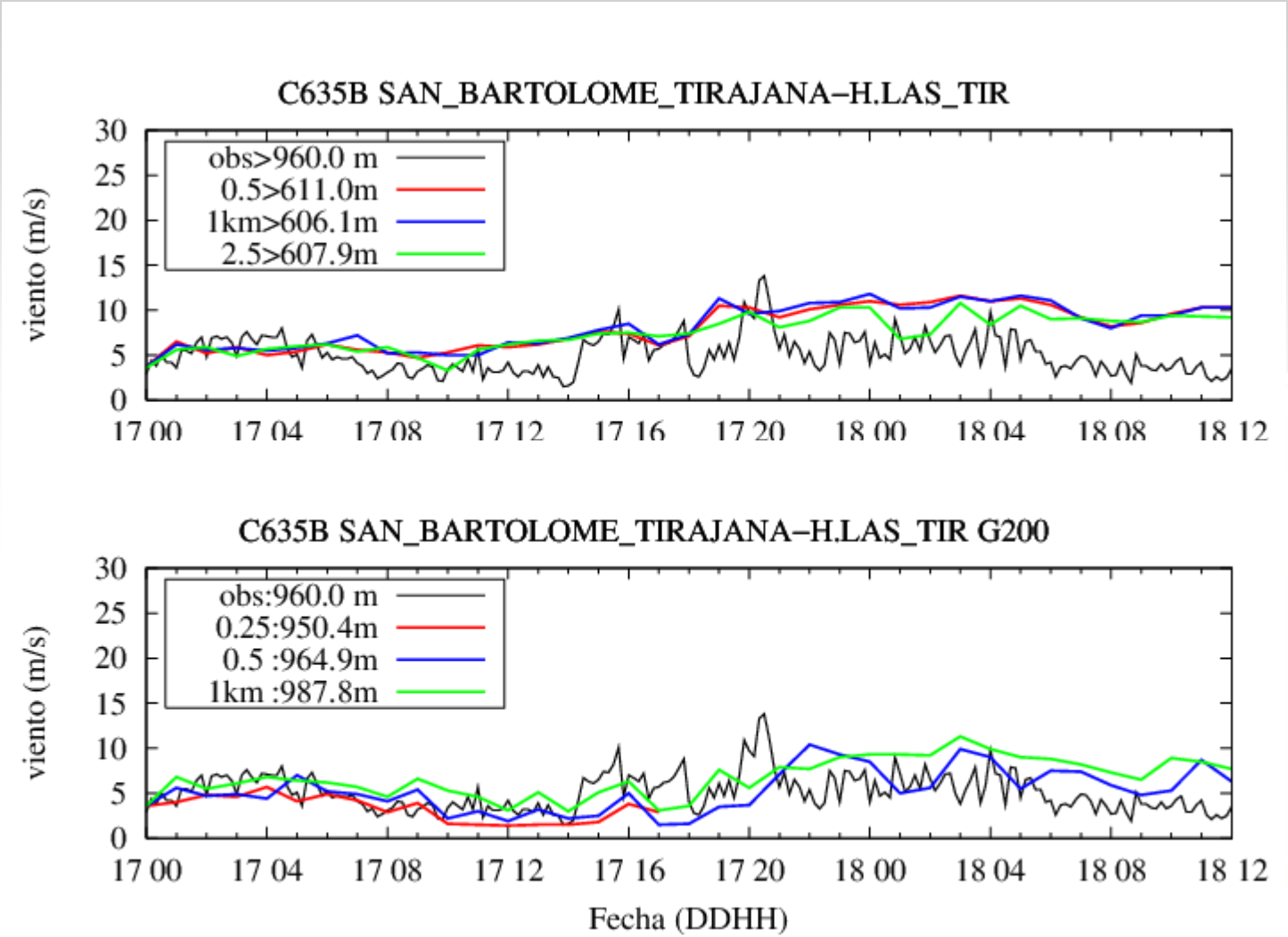
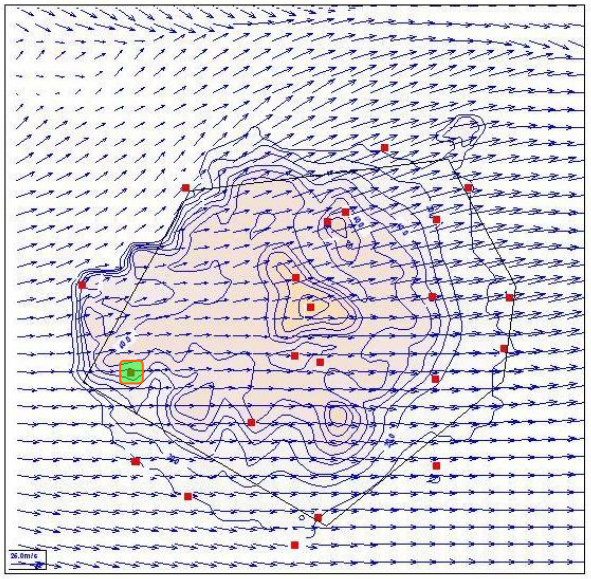




Verification: Model vs. Observation





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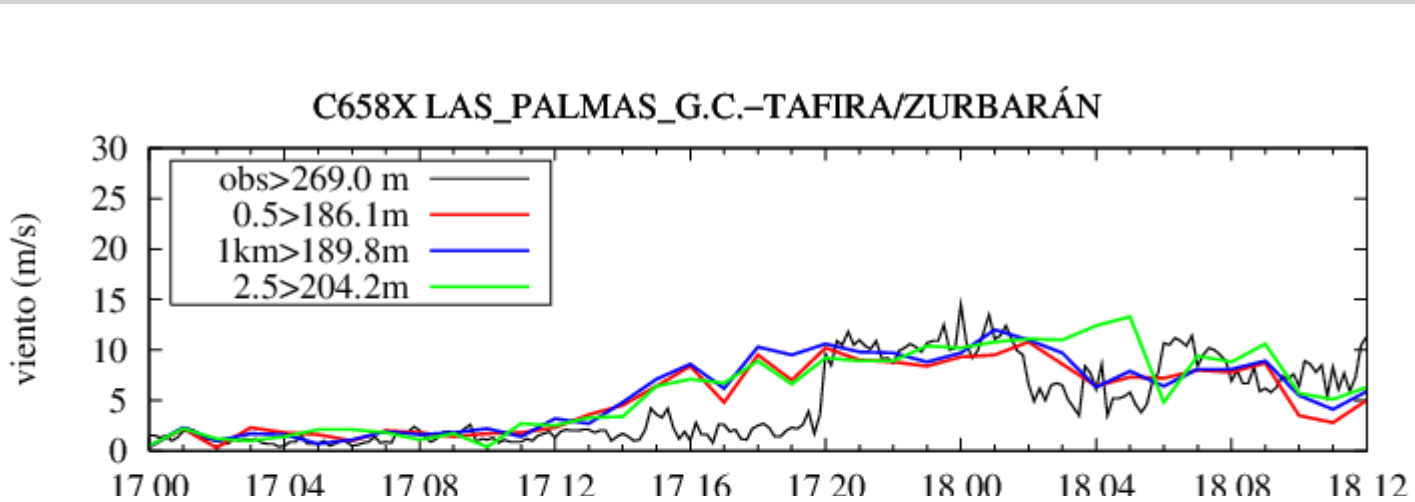

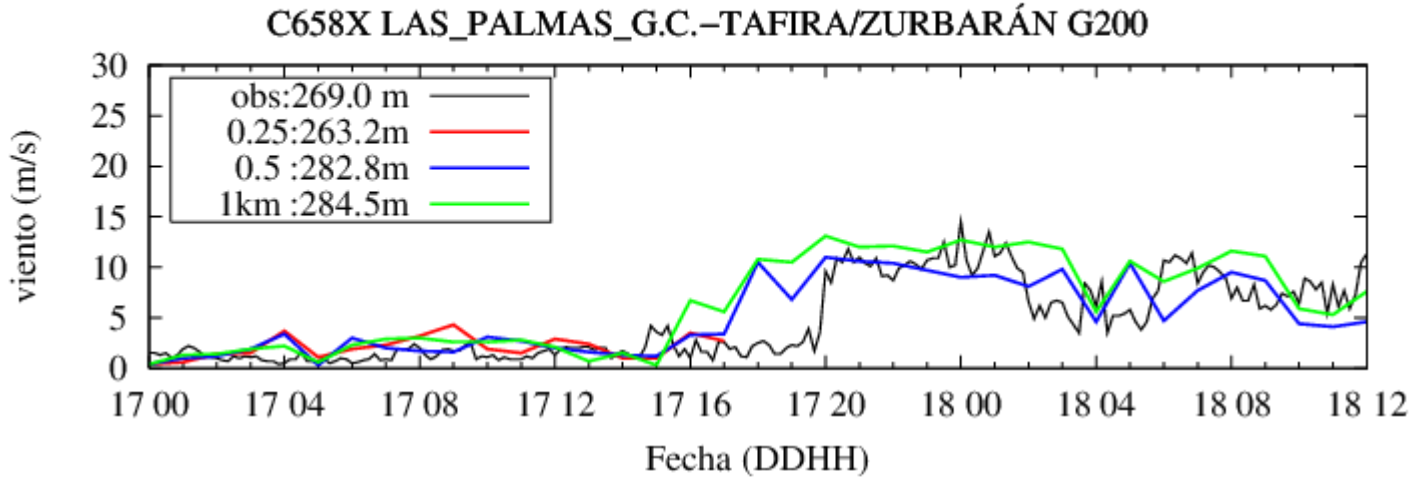

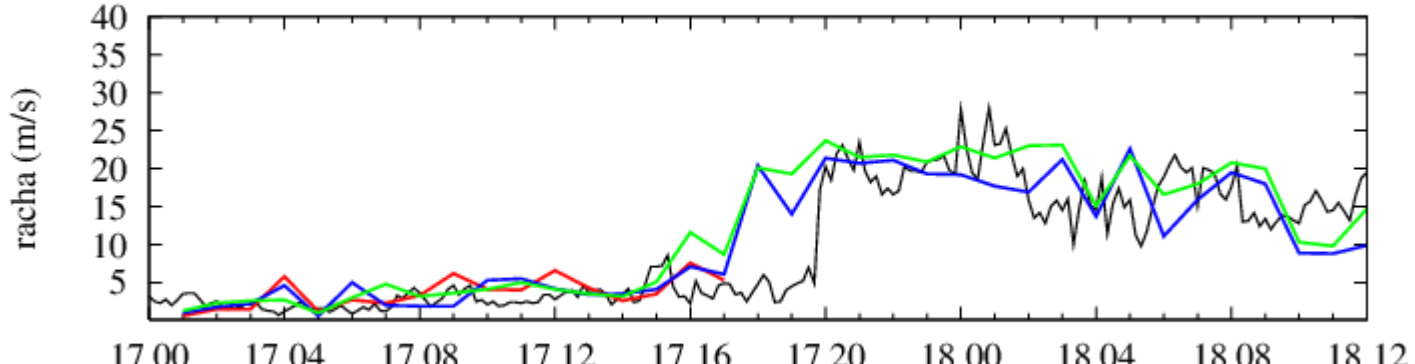

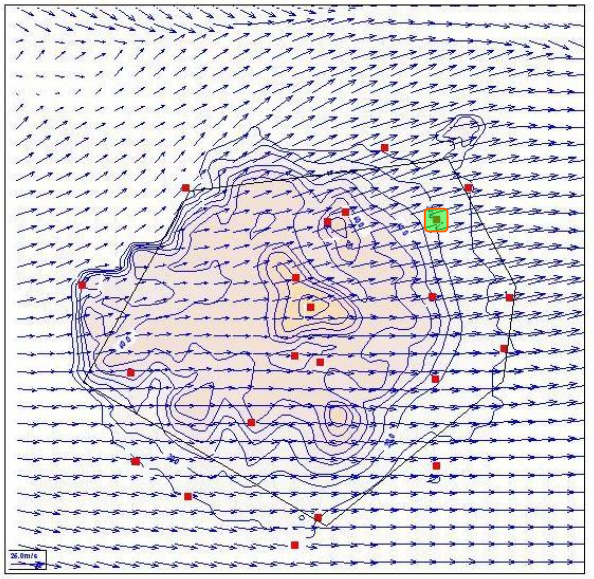

Conclusions and further work

- Conclusions:
- HARMONIE has been run at 2.5, 1, 0.5 and 0.250 km resolutions
- Current altitude from in GTOPO30 format has a resolution of 1 km. A new data set from the Instituto Geografico at 200m resolution has been tested.
- We have found stability problems when going to resolutions below 1km
  - The model is more stable with physics switch on and with physics switch off leads to a to intense wind speed
  - Switching off the microphysics and keeping the surface processes gives more realistic values of the wind
- The impact of the resolution on the wind field is small and probably we need model tuning for this resolutions
- Plans for the future:
- Use physiography data at the highest possible resolution not only for elevation but also for other terrain and soil properties
  - ECOCLIMAP-II, (Corine land cover, Europe 250m). Inquire in new source of fine resolution digital elevation data like SRTM and ASTER (NASA), USGS and IGN
  - Recently the IGN has realised an elevation data set at 5 and 25 m
- Assess the wind in cases in which influence of terrain is greater
- Verified en longer periods of time
- Possibility to use this hight resolution forecast for local wind forecasting

… thanks for your attention